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(54) **STEREOLITHOGRAPHY MACHINE WITH MODELLING PLATE**

STEREOLITHOGRAPHIEMASCHINE MIT MODELLIERUNGSPLATTE

MACHINE DE STÉRÉOLITHOGRAPHIE AVEC PLAQUE DE MODELAGE

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Description

[0001] The present invention concerns a stereolithography machine comprising a modelling plate.

[0002] As is known, the stereolithography technique makes it possible to produce three-dimensional objects by superimposing a succession of layers obtained by means of a liquid resin that solidifies when subjected to a predefined stimulation.

[0003] Each layer of the object is obtained by selectively stimulating the resin so as to solidify it in the points that make up a corresponding section of the object to be produced.

[0004] As is known, a stereolithography machine generally comprises a tank suited to contain the liquid resin, a device suited to stimulate a liquid resin layer having a predefined thickness and a moving modelling plate that supports the three-dimensional object during its formation.

[0005] To create the first layer of the object, the surface of the plate is brought to the level of the above mentioned liquid layer to be stimulated, so that the first layer of the object is formed against the plate and adheres to it.

[0006] To create each successive layer, the plate moves the object away from the previous position, so as to allow the resin to restore the liquid layer that will serve to form the successive layer.

[0007] Then the plate moves the object back to such a position that the last layer is against the liquid resin layer, so that the latter solidifies while adhering to the previous layer.

[0008] The stereolithography machines of known type pose the drawback that it is not easy to remove the finished object from the modelling plate.

[0009] In particular, since the object adheres to the plate and is very fragile, it must be detached using a sharp metal blade that is slid over the plate to separate the object from the surface of the plate itself.

[0010] This operation involves the risk of deforming or breaking the object and therefore it must be carried out manually and with great care, with the drawback of increasing labour costs and the risk of rejects.

[0011] The blade poses another drawback lying in that some surface particles are removed from the plate.

[0012] Besides damaging the plate, this causes another drawback, represented by the fact that the above mentioned particles contaminate the residual liquid resin present in the tank, thus affecting the soundness of the objects that are produced successively.

[0013] Further drawbacks are posed by the stereolithography machines in which the stimulation device is positioned under the tank, which is provided with a bottom that is transparent to stimulation.

[0014] In this variant, the stimulation device is configured so as to solidify the resin layer adjacent to the bottom of the tank itself, so that the object is formed under the modelling plate and on creation of each successive layer the plate is progressively lifted from the bottom of the

tank.

[0015] The vertical movements of the plate cause the resin to flow from the centre of the plate towards its sides and vice versa, depending on the direction of movement.

[0016] Due to the viscosity of the resin and its consequent difficulty in flowing, the movement of the plate exerts a certain pressure on the bottom of the tank, which increases in proportion to the viscosity of the resin, the plate movement speed and the proximity of the plate to the bottom of the tank.

[0017] In particular, during the formation of the first layers, the modelling plate is arranged at a distance from the bottom of the tank in the order of a few hundredths of a millimetre.

[0018] Therefore, during the formation of the first layers, the pressures determined by the movements of the plate are so high that it is necessary to limit the plate speed, with the inconvenience of considerably increasing the processing costs. The problem described above is addressed in the Italian patent application VI2008A000311, in the name of the same applicant who filed the present application, and in document US 2008/0174050.

[0019] These documents disclose a stereolithography machine as per the preamble of claim 1 comprising a plate provided with through holes that, allowing the resin to flow from one face of the plate to the other, prevent the resin from flowing towards the sides of the plate. Therefore, advantageously, the presence of the holes reduces the amount of pressure exerted on the bottom of the tank and makes it possible to increase the plate movement speed even during the formation of the first layers. Furthermore, the holes prevent the plate from adhering to the bottom of the tank, producing the so-called "sucker effect" described in detail in the above mentioned document of the known art.

[0020] However, the holed plate poses the same drawbacks described above with reference to the removal of the object and to the cleaning of the plate, as well as adding new drawbacks.

[0021] It is known, in fact, that in order to make the layers adhere to the surface of the plate it is necessary to stimulate a layer of resin slightly thicker than is strictly required.

[0022] Consequently, when a holed plate is used, part of the resin belonging to the first layers of the object solidifies inside the holes and remains stuck therein, thus hindering the successive removal of the plate at the end of the processing cycle.

[0023] In particular, if the object is removed by means of the above mentioned sharp metal blade, there is the inconvenience that the portions of resin that solidified in the holes are separated from the rest of the object and remain stuck in the holes.

[0024] Therefore, after removing the object, a further operation is necessary to remove the resin that is stuck in the holes.

[0025] Differently from the variant embodiment de-

scribed above, a further variant embodiment of a stereolithography machine has the stimulation device arranged over the tank and configured so as to solidify the surface layer of the resin.

[0026] In this embodiment, the object is formed over the plate, which is progressively lowered as the construction of the object proceeds.

[0027] Even if this variant embodiment does not pose the drawbacks related to the pressure exerted on the bottom of the tank, it nevertheless poses the drawbacks related to the removal of the object from the plate and to the cleaning of the latter, described with reference to the previous variant embodiment.

[0028] The present invention intends to overcome all the drawbacks of the known art as outlined above.

[0029] In particular, it is a first object of the invention to provide a stereolithography machine with a modelling plate that allows the finished object to be removed more comfortably than allowed by the plates of known type.

[0030] It is a further object of the invention to provide a machine with a plate that is easy to clean.

[0031] It is also the object of the invention to provide a machine with a plate that, when used on a stereolithography machine provided with a stimulation device arranged under the tank, facilitates the flow of the resin from the centre of the plate towards its sides, and vice versa, compared to the plates of known type.

[0032] The objects described above are achieved by a stereolithography machine according to claim 1.

[0033] Further characteristics and details of the invention are described in the corresponding dependent claims.

[0034] Advantageously, making it easier to remove the object from the plate means reducing the need for labour and the number of rejects.

[0035] Furthermore, making it easier to clean the plate means reducing the risk of contaminating the resin and thus also means offering the corresponding advantages.

[0036] Still advantageously, the easier flow of the resin allows plate movement speeds to be adopted that are analogous to those achievable with holed plates of known type.

[0037] Therefore, it is possible to reduce the processing time of a single object and thus reduce its cost.

[0038] The said objects and advantages, together with others which will be highlighted below, are illustrated in the description of preferred embodiments of the invention which are provided by way of non-limiting examples with reference to the attached drawings, wherein:

- Figure 1 shows an axonometric view of the stereolithography machine that is the subject of the invention;
- Figure 2 shows a side section view of the machine shown in Figure 1;
- Figure 2a shows an enlarged detail of Figure 2;
- Figure 3 shows an axonometric view of the modelling plate;

- Figure 4 shows a side section view of a detail of the plate shown in Figure 3;
- Figures 4a and 4b show in detail a side section view of several variant embodiments of the plate shown in Figure 4;
- Figure 5 shows an axonometric view of a tool for cleaning the plate;
- Figure 6 shows a partial section view of the tool shown in Figure 5;
- Figure 7 illustrates the use of the tool of Figure 5 with the plate of Figure 3;
- Figure 8 shows a side section view of a detail of Figure 7.

[0039] As shown in Figure 1, the stereolithography machine **1** of the invention comprises a tank **2** suited to contain a liquid substance **3** suited to solidify when subjected to a selective stimulation **4**, shown in Figure 2.

[0040] The above mentioned selective stimulation **4** is generated through emission means **5** that convey it towards the tank **2**.

[0041] Preferably but not necessarily the liquid substance **3** is a light-sensitive resin and the emission means **5** comprise a laser emitter associated with scanner means **5a** of any known type suited to direct the laser beam on the points of the layer of resin **3** to be solidified.

[0042] Obviously, variant embodiments may include other known types of emission means **5**, provided that they can solidify the liquid substance **3**.

[0043] The machine **1** also comprises a modelling plate **6**, provided with a work surface **7** facing said emission means **5** and suited to support a three-dimensional object **A** being formed.

[0044] The machine **1** described above makes it possible to produce the three-dimensional object **A** by superimposing a plurality of layers **E** of said solidified resin **3** having a predefined thickness.

[0045] In particular, the first layers adhere to the work surface **7** of the plate **6**, while the successive layers adhere to the previous ones.

[0046] Preferably but not necessarily the machine **1** is configured so as to form the object **A** under the modelling plate **6**, as shown in Figures 1 and 2.

[0047] In particular, the emission means **5** are arranged under the tank **2** that has a bottom **2a** that is transparent to stimulation **4**.

[0048] Obviously, in this case, the plate **6** is arranged with the work surface **7** facing the bottom **2a** of the tank **2**.

[0049] According to a variant embodiment of the stereolithography machine, not shown herein, the emission means **5** are arranged over the tank **2**.

[0050] In this second variant embodiment, the modelling plate **6** is arranged with the work surface **7** facing upwards and the three-dimensional object **A** is formed over the plate.

[0051] The plate **6** comprises a plurality of grooves **8** made in the work surface **7** along corresponding development trajectories parallel to one another and preferably

rectilinear, as shown in Figure 3.

[0052] During the formation of the first layers **E** of the object **A** adjacent to the work surface **7** of the plate **6**, the resin **3'** located in the grooves **8** is not reached by the stimulation **4** and, therefore, remains liquid, thus defining a corresponding number of channels interposed between the solidified object **A** and the plate **6**, as shown in Figure 2a.

[0053] At the end of the processing cycle, a corresponding elongated element **16** belonging to a cleaning tool **14**, shown in Figure 5, can be inserted and slid into each one of the above mentioned channels.

[0054] The elongated element **16** can exert a thrusting action on the three-dimensional object **A** in order to detach it from the work surface **7**, as shown in Figure 8.

[0055] Therefore, the above mentioned grooves **8** make it easier to detach the finished object **A** from the work surface **7**, thus achieving one of the objects of the invention.

[0056] Advantageously, the above mentioned thrusting action poses fewer risks of damaging the object **A** than the known techniques, according to which the object **A** is removed using a sharp tool.

[0057] Furthermore, advantageously, the tool **14** is not provided with a cutting edge and therefore cannot damage the plate **6**.

[0058] Furthermore, as the object **A** is removed completely, it does not leave solid residues inside the grooves **8**, thus achieving the further object to facilitate the cleaning of the plate **6**.

[0059] The grooves **8** preferably extend to the perimeter edge of the work surface **7**, opening up at the level of the lateral surface of the modelling plate **6**, as clearly visible in Figure 3.

[0060] It is clear that the above mentioned open end allows the resin **3** to flow from the grooves **8** towards the lateral area of the plate **6**, and vice versa, during the vertical movement of the plate **6** itself.

[0061] Preferably, both ends of the grooves **8** are open at the level of the lateral surface of the plate **6**, advantageously allowing the resin **3** to flow in both directions.

[0062] Therefore, if the plate **6** is arranged with the work surface **7** facing the bottom **2a** of the tank **2**, the resin **3** can flow along the grooves **8** from the centre of the plate **6** towards its sides, and vice versa.

[0063] Therefore, the invention achieves the object to facilitate the flow of the resin **3**, especially when the plate **6** is arranged very near the bottom **2a** of the tank **2**. Advantageously, the facilitated flow of the resin **3** makes it possible to reduce the pressure exerted on the bottom **2a** of the tank **2** during the vertical movement of the plate **6**.

[0064] Therefore, advantageously, it is possible to select movement speeds of the plate **6** that are equivalent to those possible, for example, with holed plates of known type, and in any case exceed those allowed by other known types of plate.

[0065] The grooves **8** preferably have depths **9** ex-

ceeding the thickness of the layers **E** that make up the three-dimensional object **A**, for example in the order of tenths of a millimetre or more.

[0066] Advantageously, this makes it possible to prevent the first layers of the object **A** from clogging the grooves **8**, if solidification occurs partly inside them due to processing needs or mispositioning of the plate **6**.

[0067] The first case is the most common and derives from the fact that, to ensure the adhesion of the first layers **E** to the work surface **7** of the plate **6**, a stimulation **4** is employed whose intensity is higher than the intensity strictly necessary to solidify the layer having predefined thickness.

[0068] The higher intensity of the stimulation causes a partial solidification of the resin **3'** arranged inside the grooves **8**, as shown in Figure 2a.

[0069] The number of grooves **8**, their width and their mutual distances on the plate **6** are parameters that can be selected by the manufacturer based on the operating characteristics of the machine **1** on which the plate **6** must be used. In general, a more viscous resin **3** will require more grooves **8** in order to allow the optimal flow of the resin **3**.

[0070] A higher number of grooves **8** also facilitates the removal of the object **A** from the plate **6**.

[0071] On the other hand, a reduced number of grooves **8** increases the surface area of the work surface **7**, thus improving the adhesion of the object **A** during processing.

[0072] By way of example, it has been found that grooves **8** approximately one millimetre wide arranged at a mutual distance of about one millimetre represent a good compromise in many circumstances.

[0073] It is evident, however, that in special cases it will be possible to use even one groove **8** only.

[0074] The grooves **8** preferably develop with a uniform cross section **11** along a rectilinear trajectory **X**.

[0075] In particular, and as shown in Figure 4, the above mentioned cross section **11** is rectangular.

[0076] According to a variant embodiment of the plate, indicated in Figure 4a by reference number **6'**, the cross section **11'** has an area **12** whose width exceeds the width **10** of the same section at the level of the work surface **7**.

[0077] In other words, the cross section **11'** features an undercut surface that, advantageously, facilitates the adhesion of the three-dimensional object **A** to the groove **8** during the processing cycle.

[0078] The undercut is small enough not to hinder the removal of the finished three-dimensional object **A** from the plate **6**.

[0079] Preferably but not necessarily the above mentioned cross section **11** has the shape of a trapezium, with the long base defining the bottom **2a** of the groove **8** and the short base **10** corresponding to the opening of the groove **8** on the work surface **7**.

[0080] According to a further variant embodiment, indicated in Figure 4b by reference number **6''**, the profile of the cross section **11''** features a recess **13** on one or

both of the edges that delimit the cross section 11" laterally.

[0081] Advantageously, said recess 13 further improves the adhesion of the three-dimensional object A to the plate 6 during the processing cycle.

[0082] The depth of the above mentioned recess 13 is preferably limited to a few tenths of a millimetre, in such a way as not to hinder the successive removal of the object A.

[0083] It is obvious that other variant embodiments may have the characteristics of the previous two embodiments, combined together.

[0084] The cleaning tool 14 shown in Figure 5 comprises a supporting body 15 from which one or more mutually parallel elongated elements 16 develop, each one of which is configured so as to slide inside a corresponding groove 8 of the plate 6.

[0085] The elongated elements 16 are arranged according to a reference plane Y and feature mutual distances that are the same as the mutual distances between the corresponding grooves 8.

[0086] The sliding of the elongated elements 16 inside the corresponding grooves 8 of the plate 6 makes it possible to exert a thrusting action on the three-dimensional object A that, advantageously, causes it to be removed from the work surface 7, as shown in Figures 7 and 8.

[0087] Preferably but not necessarily the tool 14 is provided with a number of elongated elements 16 equal to the number of grooves 8 of the plate 6, in such a way as to allow the removal of the three-dimensional object A with one pass only.

[0088] It is evident, however, that the tool 14 can be provided with any number of elongated elements 16, even lower than the number of grooves 8.

[0089] As shown in Figure 6, the width 17 of each elongated element 16 with respect to a direction parallel to the reference plane Y is preferably uniform and substantially equal to the width of the corresponding groove 8 of the plate 6.

[0090] In this way, advantageously, each elongated element 16 has the maximum width compatible with the corresponding groove 8, thus allowing better distribution of the thrusting action on the three-dimensional object A.

[0091] The thickness 18 of the elongated elements 16 with respect to a direction orthogonal to the reference plane Y is preferably uniform along the direction of development of the elongated elements 16.

[0092] Furthermore, the thickness 18 preferably does not exceed the depth 9 of the corresponding groove 8, so as to advantageously make it possible to comfortably insert the elongated elements 16 between the three-dimensional object A and the plate 6.

[0093] It is also preferable that the thickness 18 of the elongated elements 16 be less than the depth 9 of the grooves 8, so as to facilitate the penetration of the elongated elements 16 even when the resin 3 solidifies partially inside the grooves 8, as described above.

[0094] According to a variant embodiment, not illus-

trated herein, the elongated elements 16 have increasing cross section from the end towards the supporting body 15, thus serving as wedges.

[0095] The elongated elements 16 preferably have rounded ends 16a that advantageously facilitate their insertion in the corresponding grooves 8, as shown in Figure 8.

[0096] The elongated elements 16 are preferably made of a flexible material, in particular a plastic material, with the advantage of allowing a more gradual force to be exerted on the object A during removal from the plate 6, so as to reduce the risk of damaging it.

[0097] The elongated elements 16 in plastic material offer a further advantage lying in that their hardness is lower than the hardness of the materials commonly employed for the modelling plates, normally aluminium or other materials with similar hardness.

[0098] The reduced hardness of the elongated elements 16 prevents them from removing from the surface of the plate 6 some metal particles that may contaminate the resin 3 during the successive processing cycles, and also from damaging the plate 6.

[0099] The tool 14 can obviously be entirely made of a plastic material, with the advantage of reducing costs.

[0100] For this purpose the depth 9 of the grooves 8 should preferably exceed 0.5 mm, and preferably be in the order of 1 mm, so that the thickness of the tool 14 is compatible with the use of a plastic material.

[0101] It is also evident that, in variant embodiments, the tool 14 can be made of any material.

[0102] Obviously, the plate 6 and the tool 14 can be supplied in a kit intended to be used in a stereolithography machine 1, which incorporates the advantages of both components.

[0103] In practice, after the construction of the three-dimensional object A has been completed, it can be comfortably removed from the plate 6 without damaging it, using the cleaning tool 14.

[0104] In particular, the ends 16a of the elongated elements 16 are inserted in the corresponding grooves 8 of the plate 6 and are then slid along the grooves 8, as shown in Figure 7.

[0105] During the sliding operation, the tool 14 is kept slightly inclined, so as to thrust the three-dimensional object A towards the outside of the plate 6 until it comes off.

[0106] Advantageously, as the three-dimensional object A is thrust at the level of its base, it remains intact during separation from the plate 6, leaving no solid residue of resin 3 stuck in the grooves 8, as shown in Figure 8.

[0107] Therefore, advantageously, the modelling plate 6 does not require further cleaning operations before being used for the production of a new three-dimensional object.

[0108] The above clearly shows that the stereolithography machine of the invention achieves all the set objects.

[0109] In particular, the grooved modelling plate

makes it particularly easy to remove the finished object from the plate itself, especially if using the tool.

[0110] The use of the tool ensures an almost perfect cleaning of the modelling plate.

[0111] Furthermore, the grooves of the plate facilitate the flow of the resin during the processing cycle, limiting the stress on the bottom of the tank and thus making it possible to increase the processing speed.

[0112] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the protection of each element identified by way of example by such reference signs.

Claims

1. Stereolithography machine (1) for the production of three-dimensional objects (A) through superimposition of a plurality of layers (E) with predefined thickness of a liquid substance (3) suited to solidify when subjected to a selective stimulation (4), comprising:
 - a tank (2) suited to contain said liquid substance (3);
 - emission means (5) suited to generate said selective stimulation (4) and to convey it towards said tank (2);
 - a modelling plate (6; 6'; 6'') comprising a work surface (7) facing the bottom (2a) of said tank (2) and suited to support said object (A); **characterized in that** said modelling plate (6; 6'; 6'') comprises at least one groove (8) made in said work surface (7) along a development trajectory (X) and extending to the perimeter edge of said work surface (7) so as to have at least one open end at the level of the lateral surface of said plate (6; 6'; 6'').
2. Machine (1) according to claim 1), **characterized in that** the depth (9) of said groove (8) exceeds the predefined thickness of said layers (E).
3. Machine (1) according to any claim 1) or 2), **characterized in that** said groove (8) has both ends open at the level of said lateral surface of said plate (6; 6'; 6'').
4. Machine (1) according to any of the preceding claims, **characterized in that** said groove (8) has a uniform cross section (11, 11', 11'') along said development trajectory (X).
5. Machine (1) according to claim 4), **characterized in that** said cross section (11') has at least one area (12) whose width exceeds the width (10) of said cross section (11') at the level of said work surface (7).
6. Machine (1) according to claim 4) or 5), **characterized in that** the profile of said cross section (11'') has a recess (13) on at least one of the side edges of said cross section (11'').
7. Machine (1) according to any of the preceding claims, **characterized in that** it comprises a plurality of said grooves (8) parallel to each other.
8. Machine (1) according to any of the preceding claims, **characterized in that** it comprises a tool (14) for cleaning said modelling plate (6; 6'; 6''), comprising a supporting body (15) from which at least one elongated element (16) develops, configured so that it can slide inside a corresponding groove (8) of said plate (6; 6'; 6'').
9. Machine (1) according to claim 8), **characterized in that** said tool (14) comprises a supporting body (15) from which a plurality of elongated elements (16) develop, each one of which is configured so that it can slide inside a corresponding groove (8) of said plate (6; 6'; 6''), said elongated elements (16) being mutually parallel and arranged according to a reference plane (Y) at mutual distances that are the same as the mutual distances between the corresponding grooves (8).
10. Machine (1) according to claim 8) or 9), **characterized in that** the width (17) of each one of said elongated elements (16) with respect to a direction parallel to said reference plane (Y) is substantially equal to the width (10) of the corresponding groove (8) of said plate (6; 6'; 6'').
11. Machine (1) according to any of the claims from 8) to 10), **characterized in that** the thickness (18) of each one of said elongated elements (16) in a direction orthogonal to said reference plane (Y) does not exceed the depth (9) of the corresponding groove (8).
12. Machine (1) according to any of the claims from 8) to 11), **characterized in that** said elongated elements (16) have rounded ends (16a).
13. Machine (1) according to any of the claims from 8) to 12), **characterized in that** said elongated elements (16) are flexible.
14. Machine (1) according to any of the claims from 8) to 13), **characterized in that** the hardness of said elongated elements (16) is lower than the hardness of said plate (6; 6'; 6'').

Patentansprüche

1. Stereolithografiemaschine (1) zur Herstellung dreidimensionaler Objekte (A) durch Überlagerung einer Vielzahl von Schichten (E) vorbestimmter Stärke einer flüssigen Substanz (3), die geeignet ist, unter Einfluss einer selektiven Stimulierung (4) zu erstarren, Folgendes umfassend:
 - einen Behälter (2), der geeignet ist, die besagte flüssige Substanz (3) zu enthalten;
 - Sendemittel (5), die geeignet sind, die besagte, selektive Stimulierung (4) zu erzeugen und auf den besagten Behälter (2) zu leiten;
 - eine Modellplatte (6; 6'; 6''), eine Arbeitsfläche (7) umfassend, welche zum Boden (2a) des besagten Behälters (2) gerichtet und geeignet ist, das besagte Objekt (A) zu tragen, **dadurch gekennzeichnet, dass** die besagte Modellplatte (6; 6'; 6'') wenigstens eine in der besagten Arbeitsfläche (7) entlang einer Bahn (X) ausgeführte Nute (8) umfasst, welche sich bis zu der Außenkante der besagten Arbeitsfläche (7) erstreckt, so dass sie auf Ebene der Seitenflächen der besagten Platte (6; 6'; 6'') wenigstens ein offenes Ende aufweist.
2. Maschine (1) gemäß Patentanspruch 1), **dadurch gekennzeichnet, dass** die Tiefe (9) der besagten Nute (8) die vorbestimmte Stärke der besagten Schichten (E) übersteigt.
3. Maschine (1) gemäß Patentanspruch 1) oder 2), **dadurch gekennzeichnet, dass** die besagte Nute (8) auf Ebene der besagten Seitenflächen der besagten Platte (6; 6'; 6'') an beiden Enden offen ist.
4. Maschine (1) gemäß eines jeden der vorstehenden Patentansprüche, **dadurch gekennzeichnet, dass** die besagte Nute (8) entlang der besagten Längsbahn (X) einen gleichförmigen Querschnitt (11; 11'; 11'') aufweist.
5. Maschine (1) gemäß Patentanspruch 4), **dadurch gekennzeichnet, dass** der besagte Querschnitt (11') wenigstens einen Bereich (12) aufweist, dessen Breite in Entsprechung der besagten Arbeitsfläche (7) die Breite (10) des besagten Querschnitts (11') übersteigt.
6. Maschine (1) gemäß Patentanspruch 4) oder 5), **dadurch gekennzeichnet, dass** das Profil des besagten Querschnitts (11'') an wenigstens einer der Seitenkanten des besagten Querschnitts (11'') eine Vertiefung (13) aufweist.
7. Maschine (1) gemäß eines jeden der vorstehenden Patentansprüche, **dadurch gekennzeichnet, dass** sie eine Vielzahl der besagten Nuten (8) aufweist, die parallel zueinander verlaufen.
8. Maschine (1) gemäß eines jeden der vorstehenden Patentansprüche, **dadurch gekennzeichnet, dass** sie ein Werkzeug (14) für die Reinigung der besagten Modellplatte (6; 6'; 6'') umfasst, welches einen Tragkörper (15) umfasst, aus dem sich wenigstens ein längliches Element (16) erstreckt, welches so konfiguriert ist, dass es innerhalb einer entsprechenden Nute (8) der besagten Platte (6; 6'; 6'') gleiten kann.
9. Maschine (1) gemäß Patentanspruch 8), **dadurch gekennzeichnet, dass** das besagte Werkzeug (14) einen Tragkörper (15) umfasst, aus dem sich eine Vielzahl länglicher Elemente (16) erstreckt, von denen jedes Einzelne so konfiguriert ist, dass es innerhalb einer entsprechenden Nute (8) der besagten Platte (6; 6'; 6'') gleiten kann, wobei die besagten, länglichen Elemente (16) wechselseitig parallel und gemäß einer Bezugsfläche (Y) in wechselseitigen Abständen angeordnet sind, welche mit den wechselseitigen Abständen zwischen den entsprechenden Nuten (8) identisch sind.
10. Maschine (1) gemäß Patentanspruch 8) oder 9), **dadurch gekennzeichnet, dass** die Breite (17) jedes der besagten, länglichen Elemente (16) bezüglich einer zur besagten Bezugsebene (Y) parallelen Richtung im Wesentlichen mit der Breite (10) der entsprechenden Nute (8) der besagten Platte (6; 6'; 6'') identisch ist.
11. Maschine (1) gemäß eines jeden der vorstehenden Patentansprüche von 8) bis 10), **dadurch gekennzeichnet, dass** die Stärke (18) jedes der besagten, länglichen Elemente (16) in einer zur Bezugsfläche (Y) lotrecht stehenden Richtung die Tiefe (9) der entsprechenden Nute (8) nicht übersteigt.
12. Maschine (1) gemäß eines jeden der vorstehenden Patentansprüche von 8) bis 11), **dadurch gekennzeichnet, dass** die besagten, länglichen Elemente (16) abgerundete Enden (16a) haben.
13. Maschine (1) gemäß eines jeden der vorstehenden Patentansprüche von 8) bis 12), **dadurch gekennzeichnet, dass** die besagten, länglichen Elemente (16) flexibel sind.
14. Maschine (1) gemäß eines jeden der vorstehenden Patentansprüche von 8) bis 13), **dadurch gekennzeichnet, dass** die Härte der besagten, länglichen Elemente (16) geringer ist als die Härte der besagten Platte (6; 6'; 6'').

Revendications

1. Machine de stéréolithographie (1) apte à produire des objets tridimensionnels (A) par superposition d'une pluralité de couches (E) d'épaisseur prédéfinie d'une substance liquide (3) indiquée pour solidifier quand elle est sujette à une stimulation sélective (4), comprenant:
 - un réservoir (2) indiqué pour contenir ladite substance liquide (3);
 - des moyens d'émission (5) indiqués pour générer ladite stimulation sélective (4) et pour la transporter vers ledit réservoir (2);
 - une plaque de modélisation (6; 6'; 6'') comprenant une surface de travail (7) se trouvant en face du fond (2a) dudit réservoir (2) et apte à supporter ledit objet (A),
caractérisée en ce que ladite plaque de modélisation (6; 6'; 6'') comprend au moins une cannelure (8) réalisée sur ladite surface de travail (7) le long d'une trajectoire de développement (X) et s'étendant au bord du périmètre de ladite surface de travail (7) de façon à obtenir au moins une extrémité ouverte au niveau de la surface latérale de ladite plaque (6; 6'; 6'').
2. Machine (1) selon la revendication 1), **caractérisée en ce que** la profondeur (9) de ladite cannelure (8) dépasse l'épaisseur prédéfinie desdites couches (E).
3. Machine (1) selon l'une quelconque des revendications 1) ou 2), **caractérisée en ce que** ladite cannelure (8) présente les deux extrémités ouvertes au niveau de ladite surface latérale de ladite plaque (6; 6'; 6'').
4. Machine (1) selon l'une quelconque des revendications précédentes, **caractérisée en ce que** la dite cannelure (8) présente une section transversale uniforme (11, 11', 11'') le long de ladite trajectoire de développement (X).
5. Machine (1) selon la revendication 4), **caractérisée en ce que** ladite section transversale (11') présente au moins une zone (12) dont la largeur est supérieure à la largeur (10) de ladite section transversale (11'') au niveau de ladite surface de travail (7).
6. Machine (1) selon la revendication 4) ou 5), **caractérisée en ce que** le profil de ladite section transversale (11'') présente une cavité (13) sur au moins un des bords latéraux de ladite section transversale (11'').
7. Machine (1) selon l'une quelconque des revendications précédentes, **caractérisée en ce qu'elle** comprend une pluralité desdites cannelures (8) parallèles entre elles.
8. Machine (1) selon l'une quelconque des revendications précédentes, **caractérisée en ce qu'elle** comprend un outil (14) pour le nettoyage de ladite plaque de modélisation (6; 6'; 6''), comprenant un corps de support (15) duquel au moins un élément allongé (16) se développe, et conçu de manière à coulisser à l'intérieur d'une cannelure correspondante (8) de ladite plaque (6; 6'; 6'').
9. Machine (1) selon la revendication 8), **caractérisée en ce que** ledit outil (14) comprend un corps de support (15) duquel une pluralité d'éléments allongés (16) se développe, chacun de ceux-ci est conçu de manière à coulisser à l'intérieur d'une cannelure correspondante (8) de ladite plaque (6; 6'; 6''), lesdits éléments allongés (16) étant réciproquement parallèles et disposés selon un plan de référence (Y) à des distances réciproques pareilles aux distances réciproques entre les cannelures correspondantes (8).
10. Machine (1) selon la revendication 8) ou 9), **caractérisée en ce que** la largeur (17) de chacun desdits éléments allongés (16) par rapport à une direction parallèle audit plan de référence (Y) est essentiellement égale à la largeur (10) de la cannelure correspondante (8) de ladite plaque (6; 6'; 6'').
11. Machine (1) selon l'une quelconque des revendications de 8) à 10), **caractérisée en ce que** l'épaisseur (18) de chacun desdits éléments allongés (16) dans une direction perpendiculaire audit plan de référence (Y) n'est pas supérieure à la profondeur (9) de la cannelure correspondante (8).
12. Machine (1) selon l'une quelconque des revendications de 8) à 11), **caractérisée en ce que** lesdits éléments allongés (16) présentent des extrémités arrondies (16a).
13. Machine (1) selon l'une quelconque des revendications de 8) à 12), **caractérisée en ce que** lesdits éléments allongés (16) sont flexibles.
14. Machine (1) selon l'une quelconque des revendications de 8) à 13), **caractérisée en ce que** la dureté desdits éléments allongés (16) est inférieure à la dureté de ladite plaque (6; 6'; 6'').

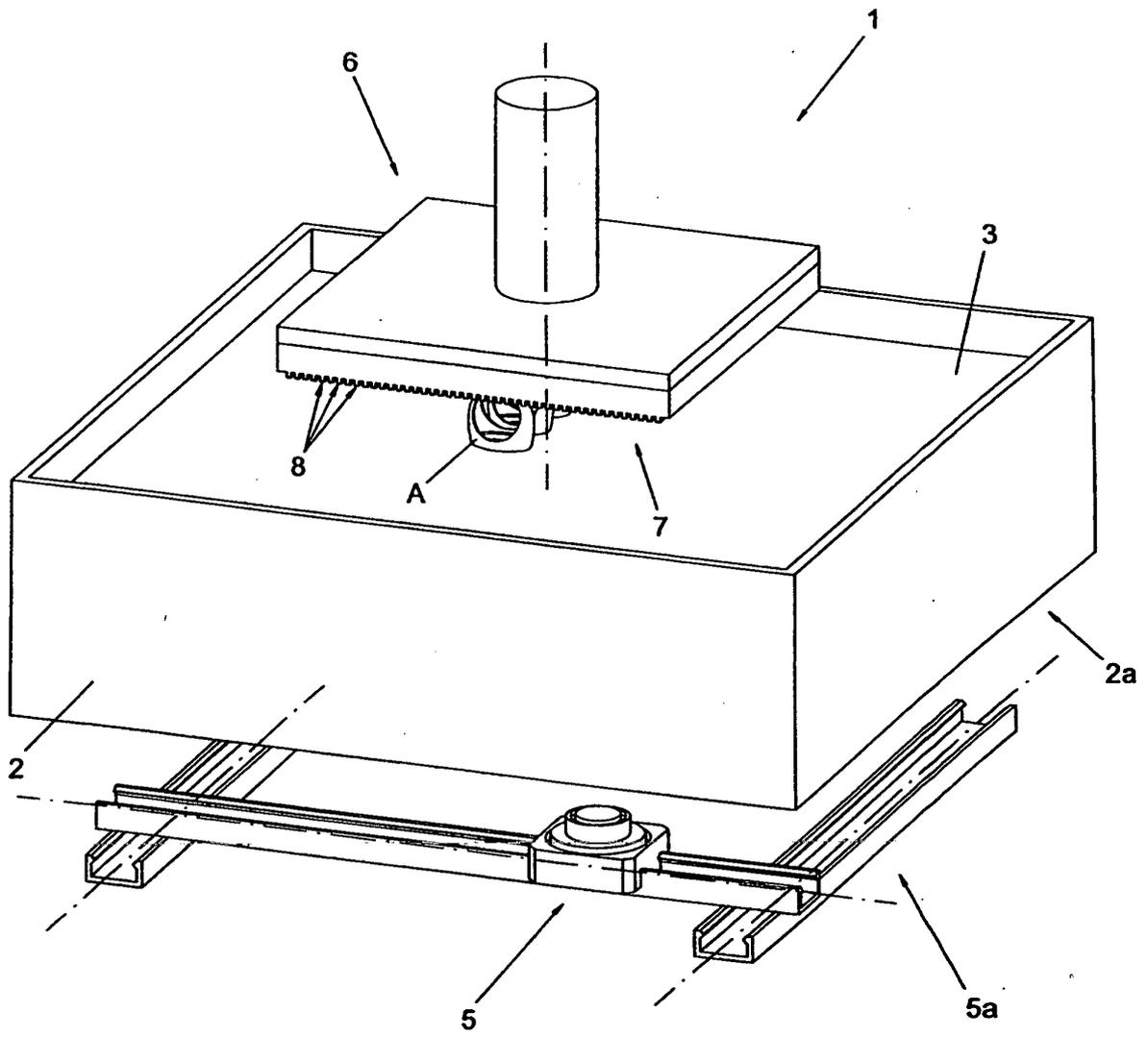


FIG. 1

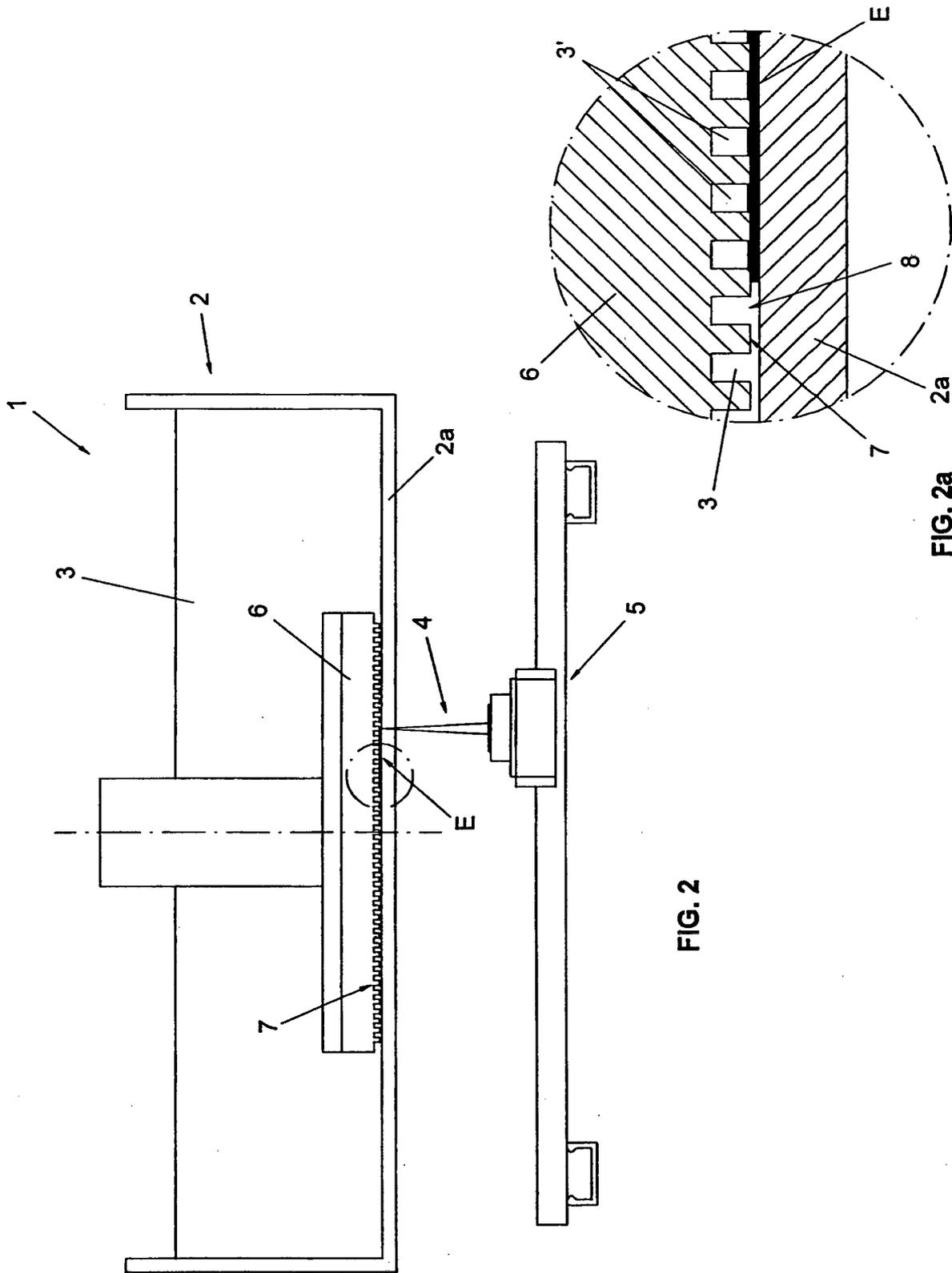


FIG. 2

FIG. 2a

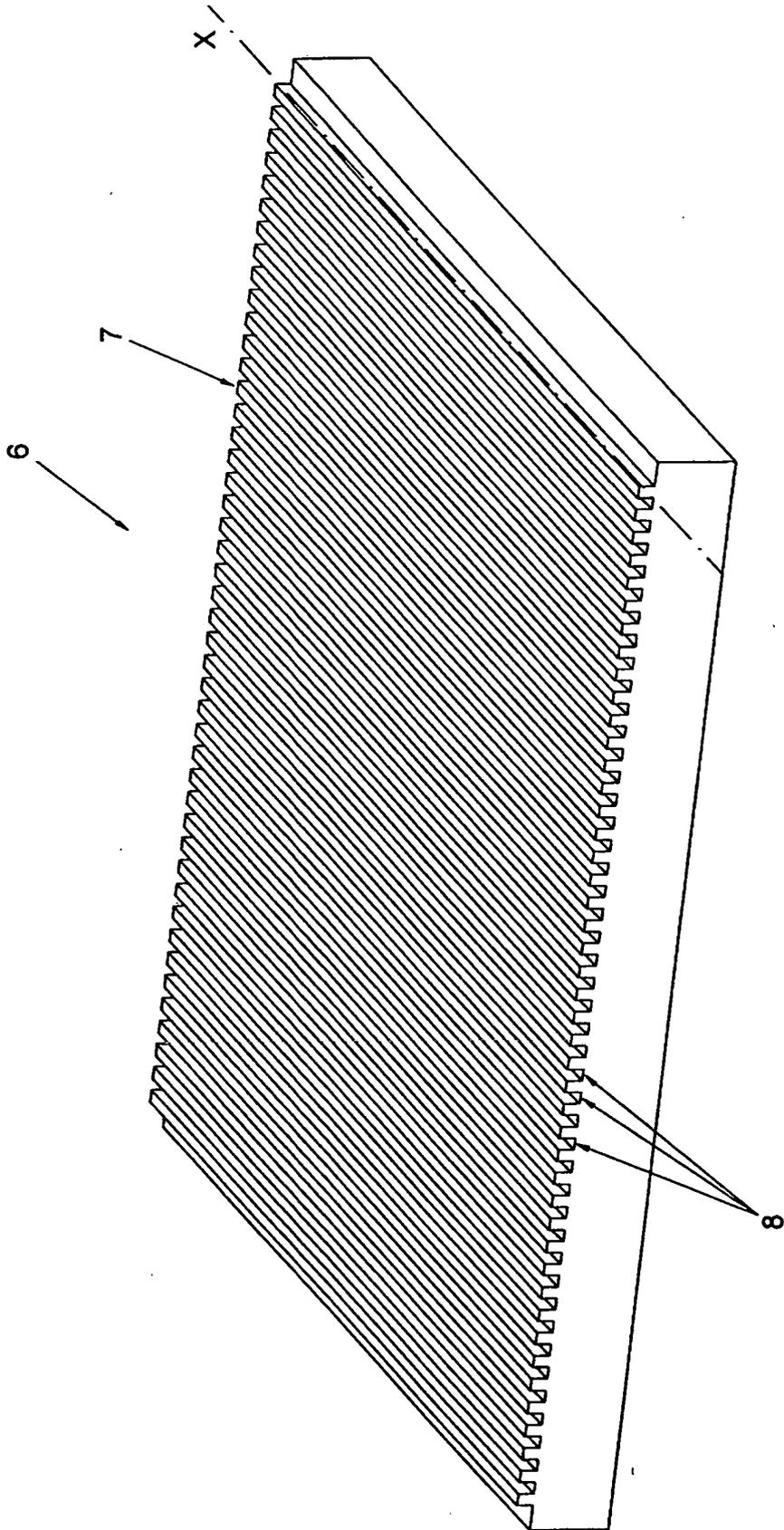
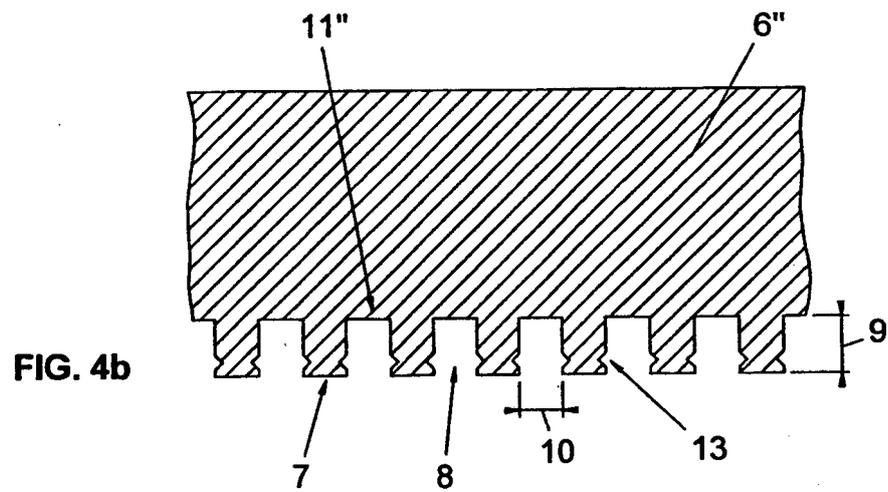
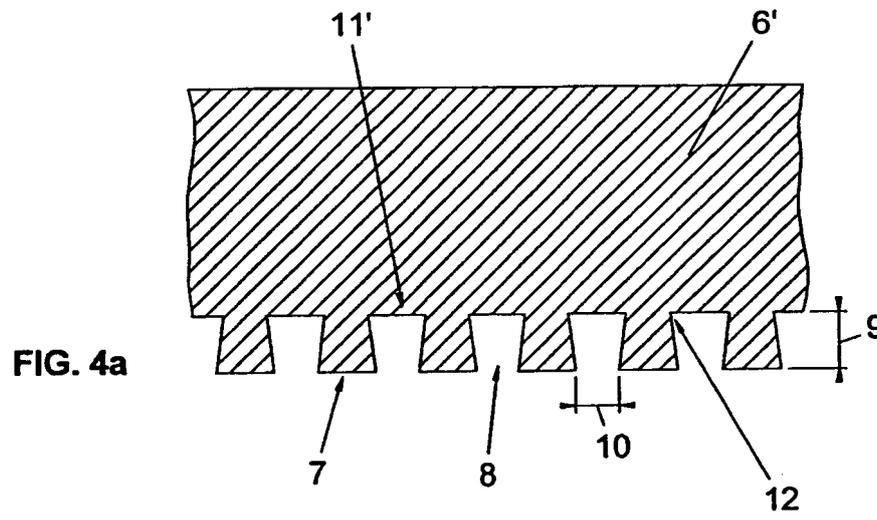
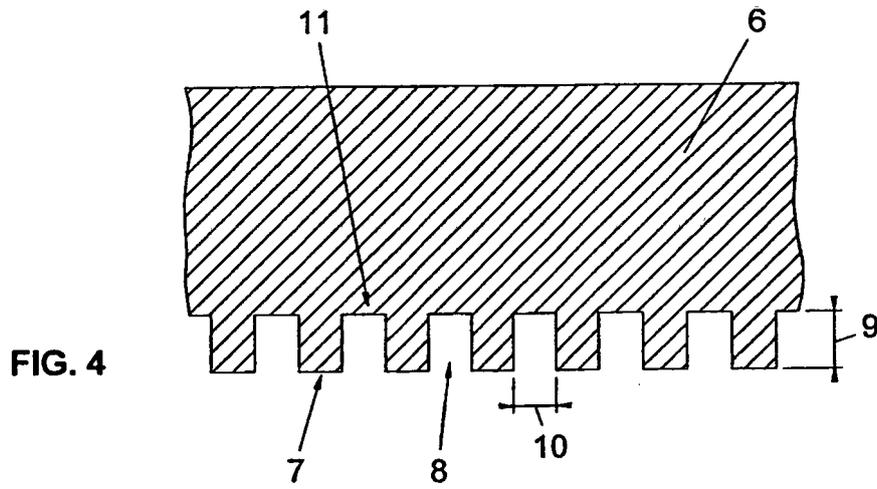


FIG. 3



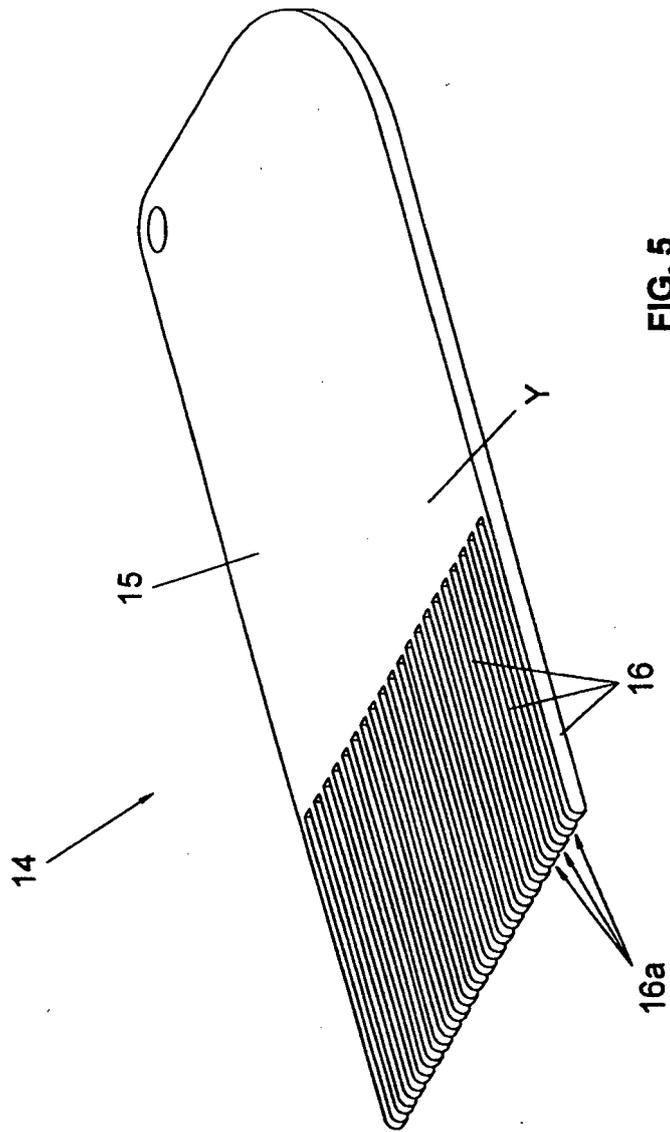


FIG. 5

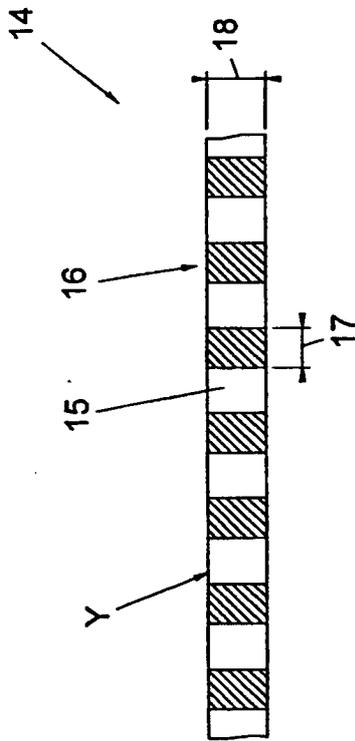


FIG. 6

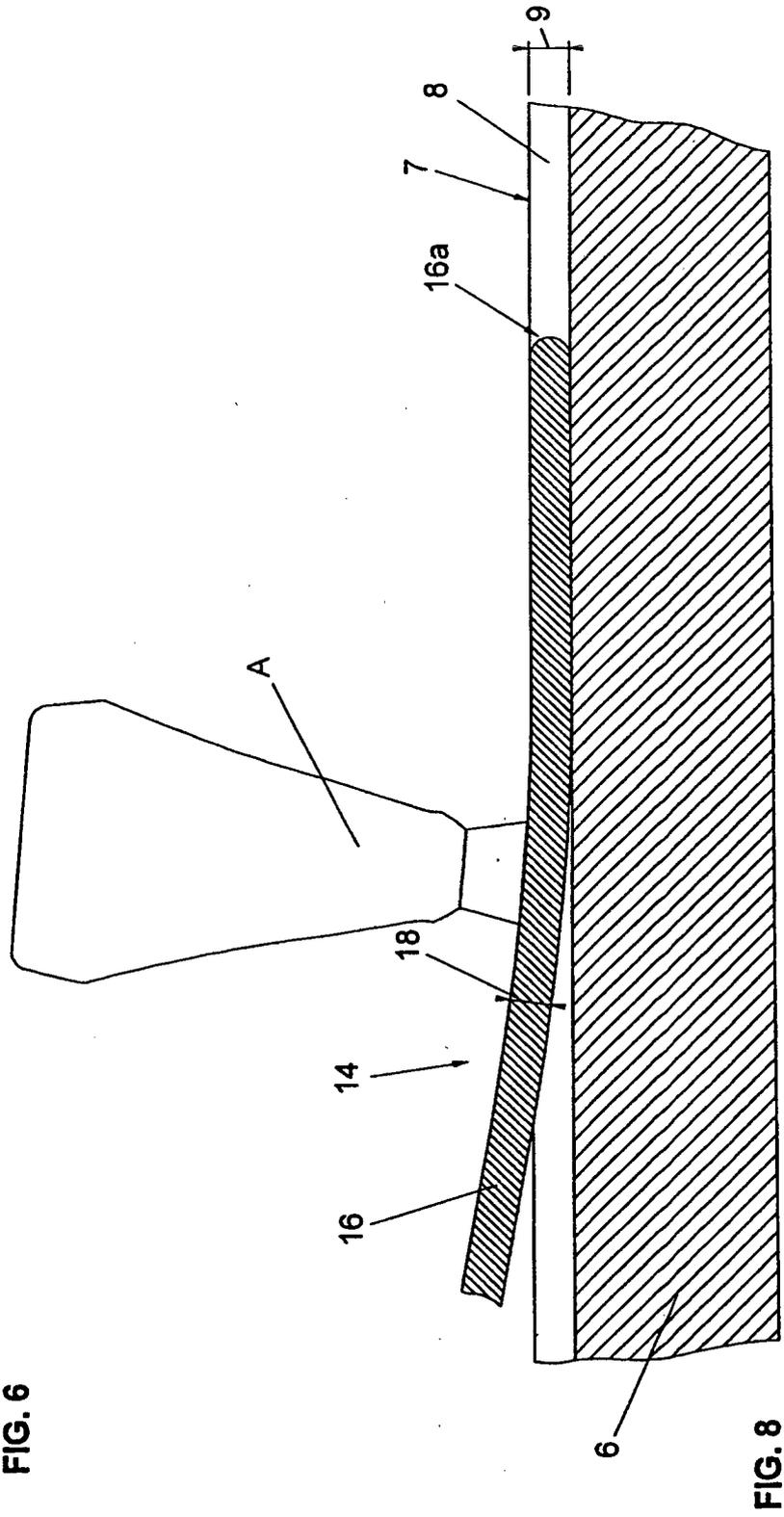


FIG. 8

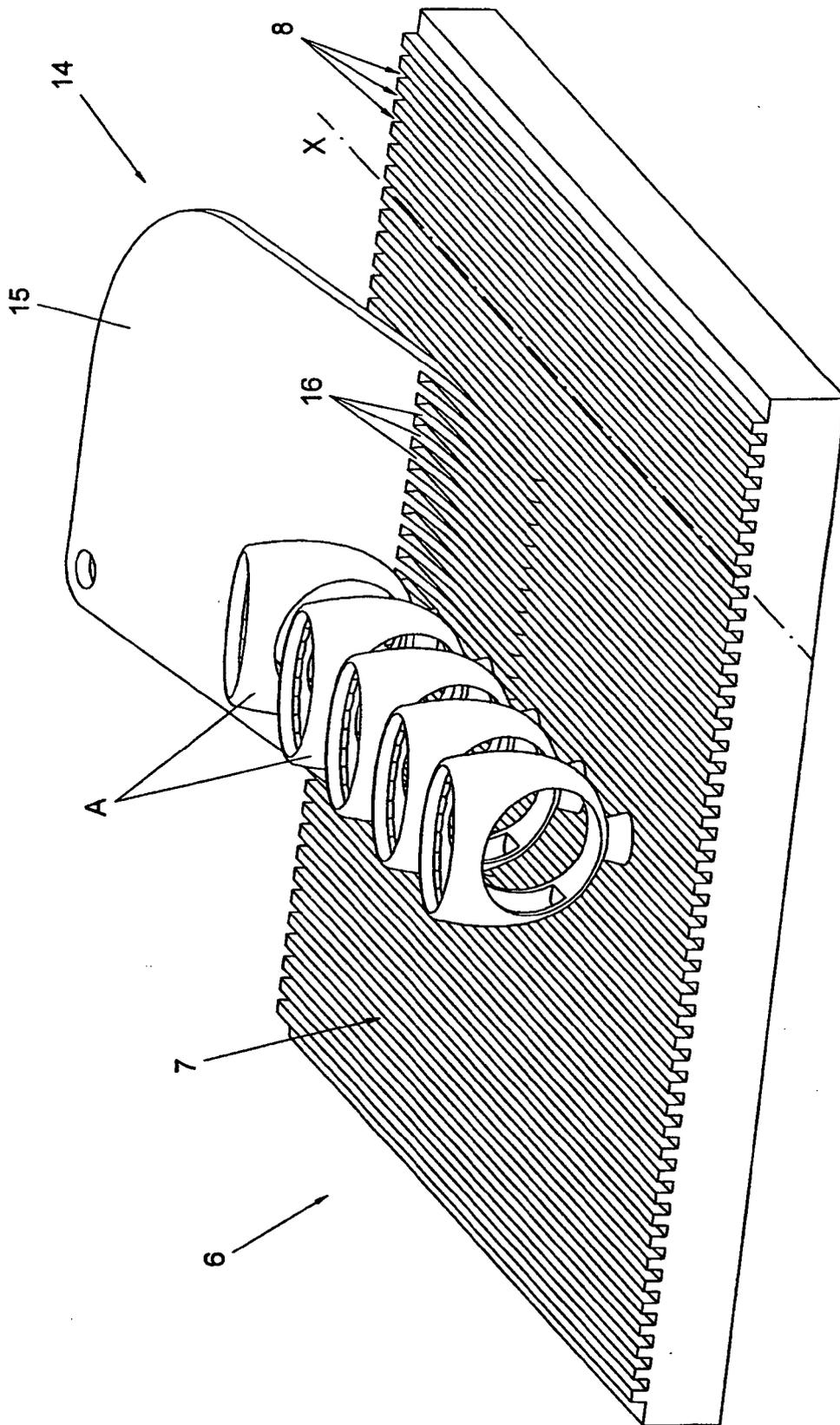


FIG. 7

REFERENCES CITED IN THE DESCRIPTION

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